FIG. Ia

FIG. Ib

O ⊙————⊙ F

FIG. Ic

FIG. Id

FIG. Ie

O1 ⊙
O2 ⊙ —— ⊙ F

FIG. If

O ⊙ —— ⊙ F1
—— ⊙ F2

FIG. Ig

FIG. Ih

FIG. 2A

FIG. 2B

22

FIG. 2C

FIG. 2D

26   24
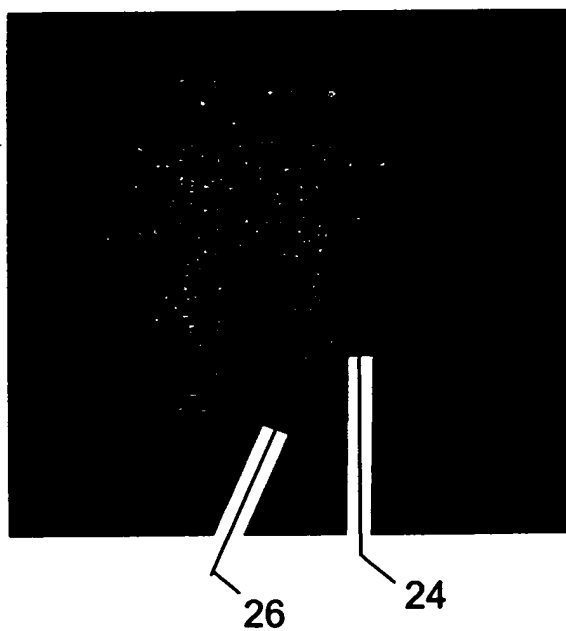
FIG. 3a
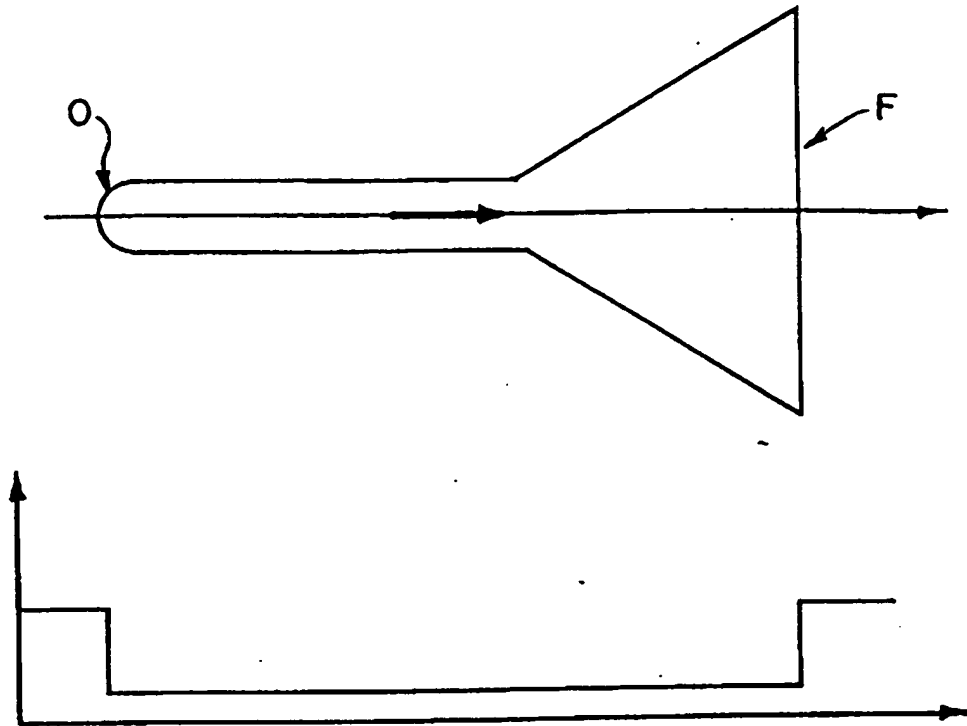
FIG. 3b

FIG. 3C

FIG. 3D

FIG. 4A
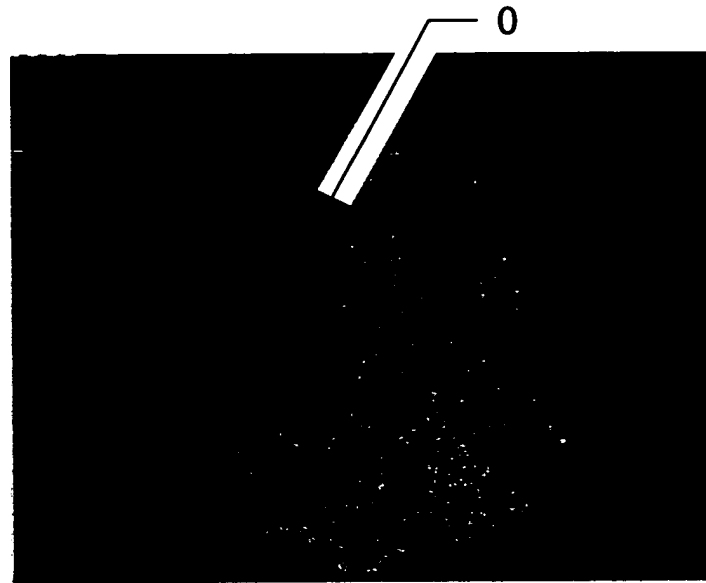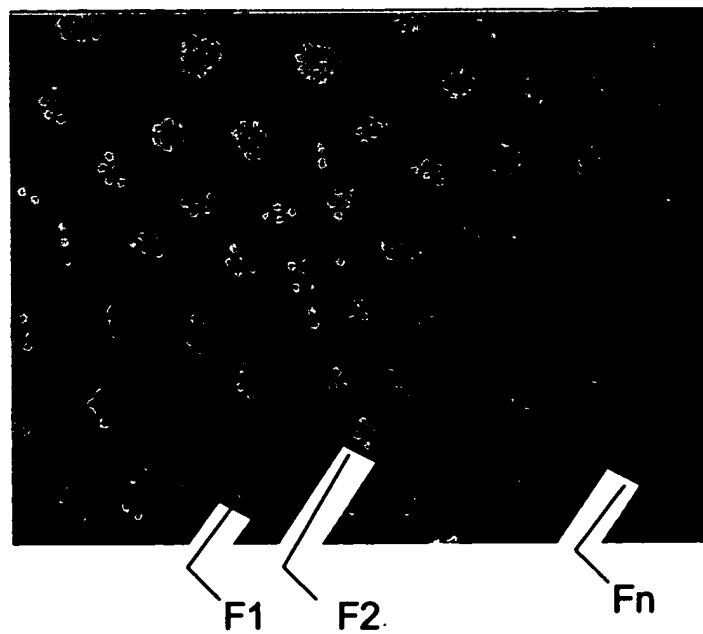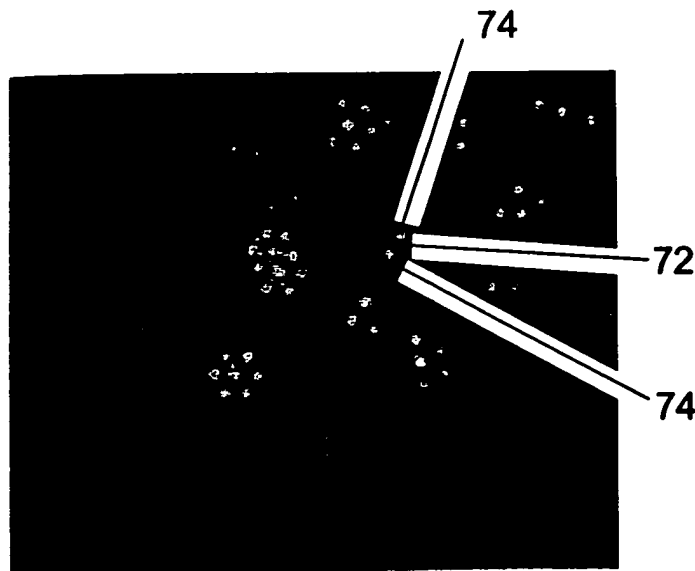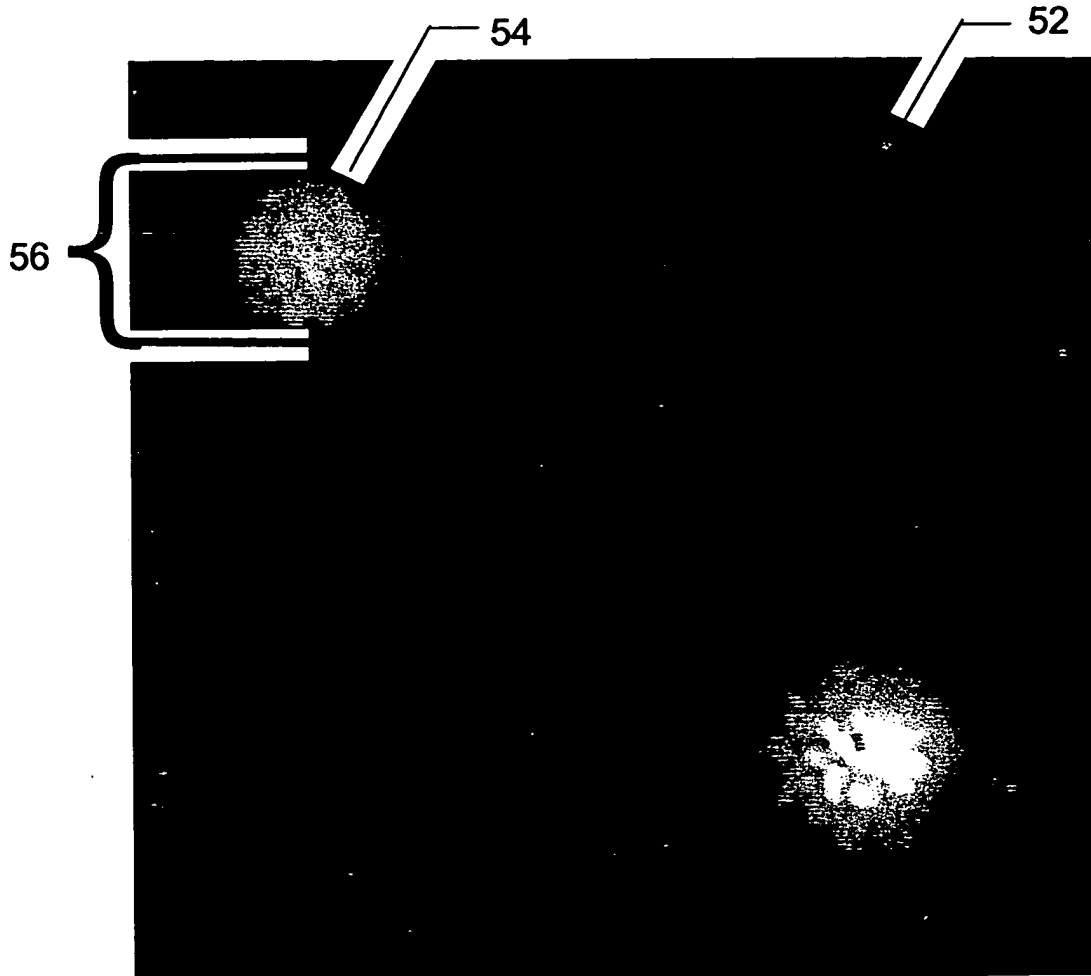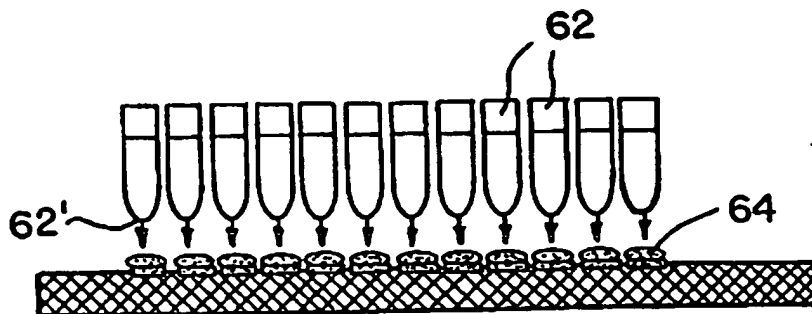
0

FIG. 4B

F1   F2   Fn

FIG. 5

54

52

56

FIG. 7

74

72

74

FIG. 6a

FIG. 6b

FIG. 6c

FIG. 8

Form Complex
on Planar Surface

Solid Phase
(Pre-form Array)

Post form
Array

Capture Complex

Form Complex
on Bead

Form Complex
in Solution

Mixed Phase

Liquid Phase

LEGEND

P— PROBE

T— TARGET

PT—P−T COMPLEX

FIG. 9a

Flow along Conduit

Transverse Flow

92

FIG. 9b

Illuminated Zone

FIG. 9c

FIG. 10

FIG. IIa

FIG. IIb

Local fluid velocity

FIG. IIc

Light

Light induced
flow field

FIG. IId
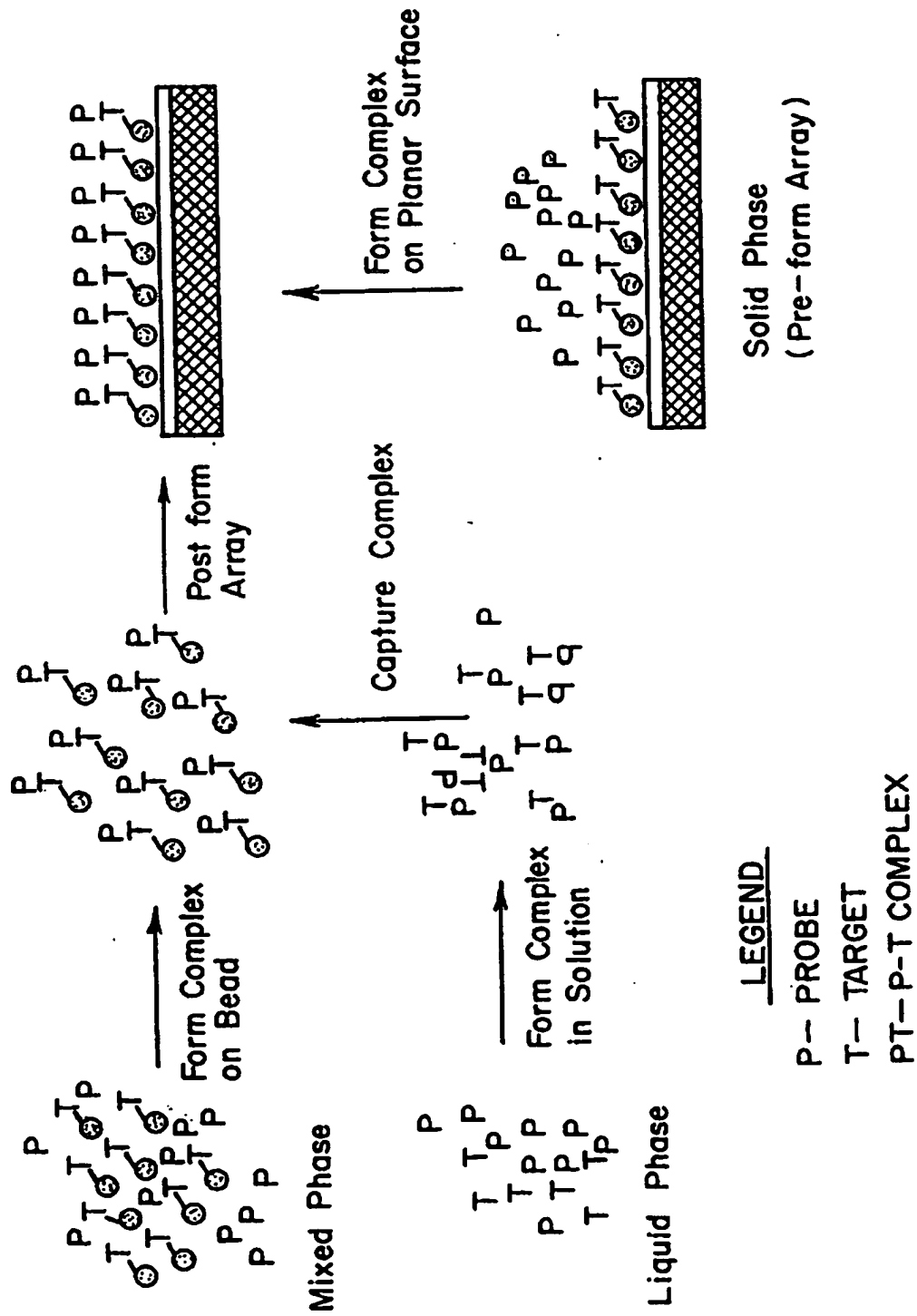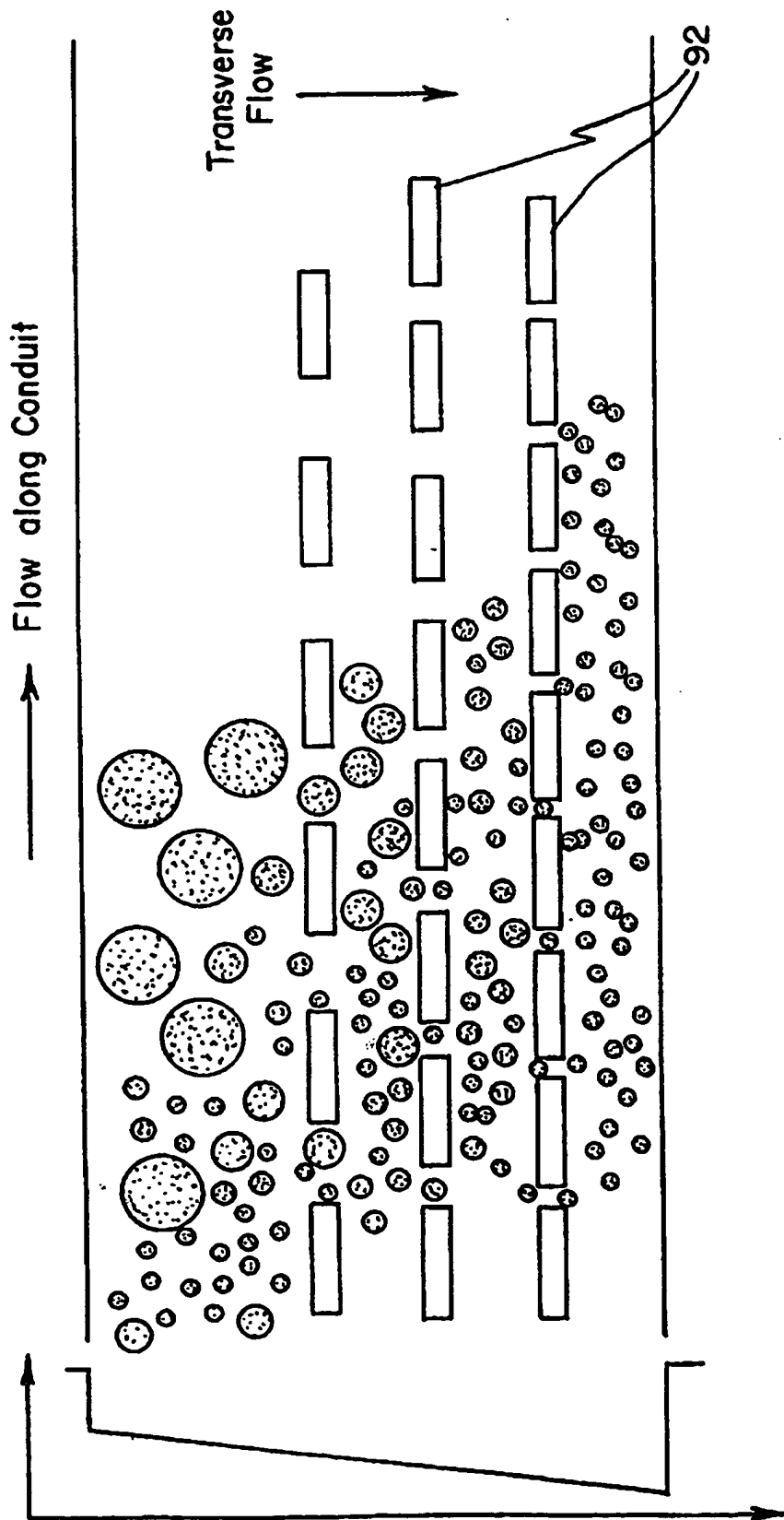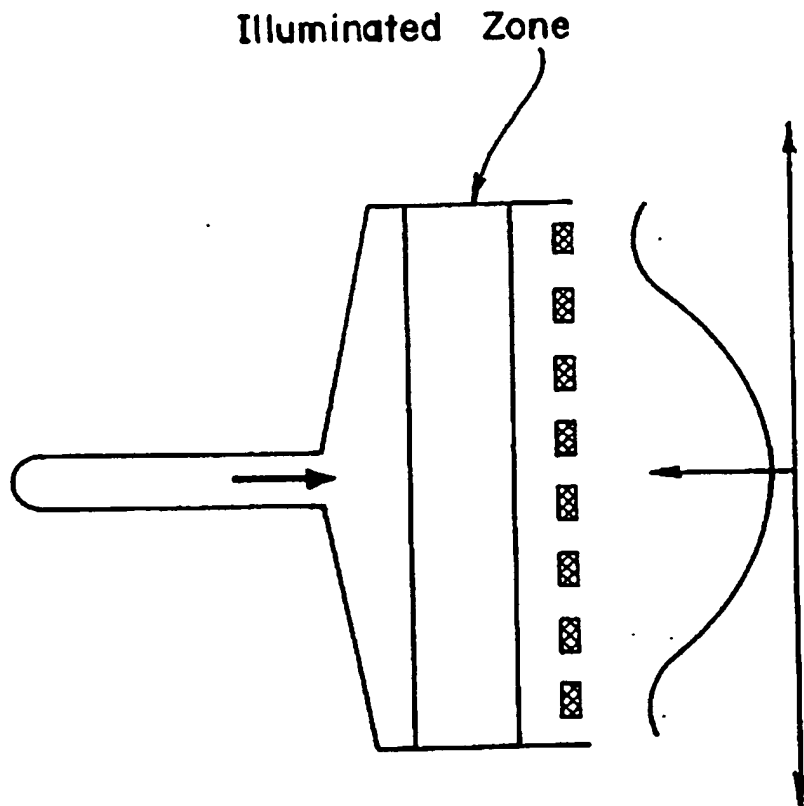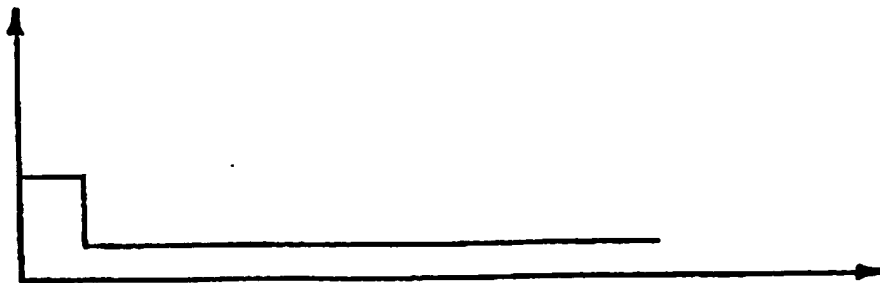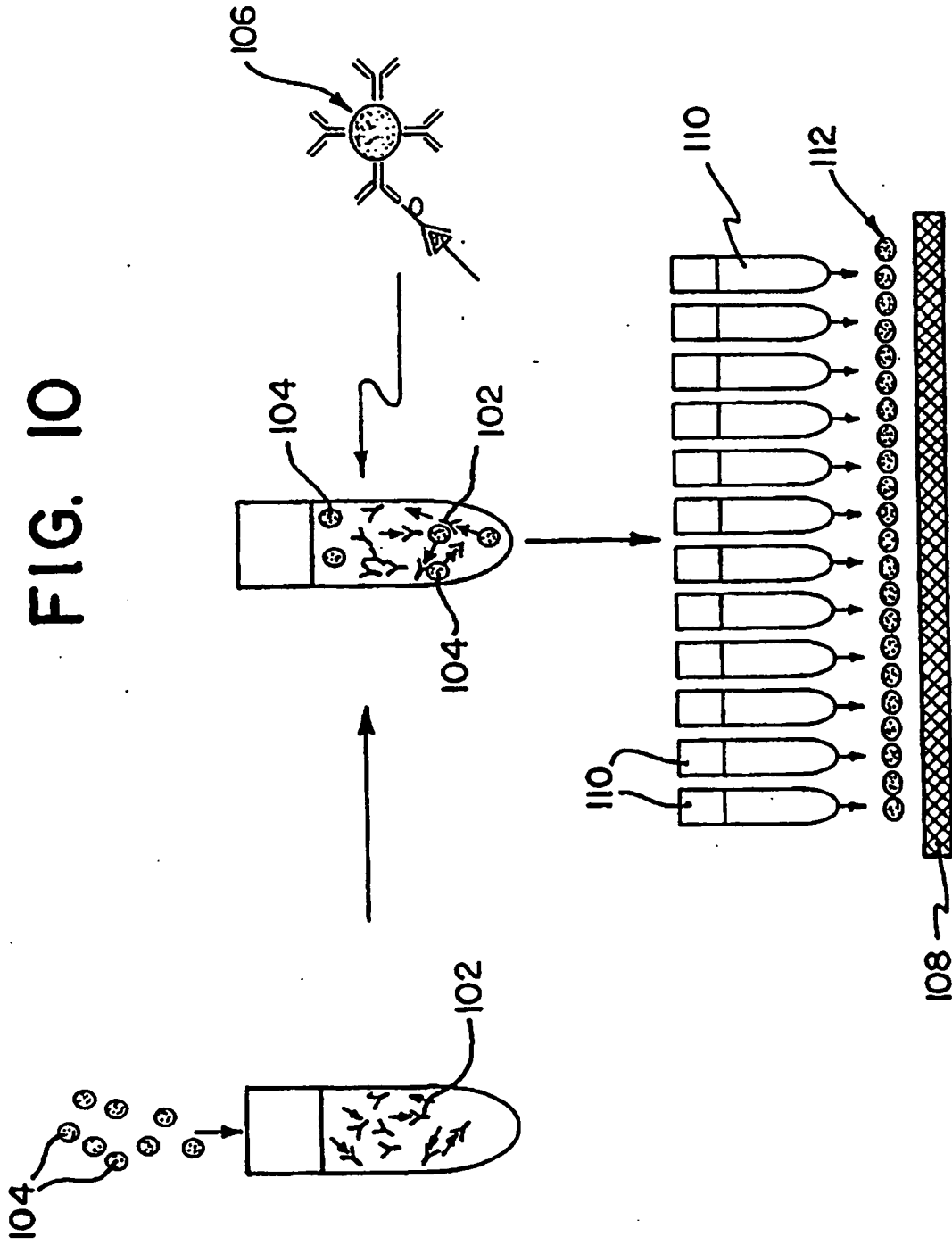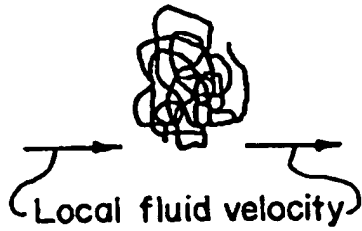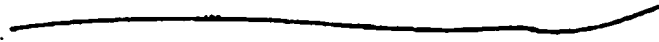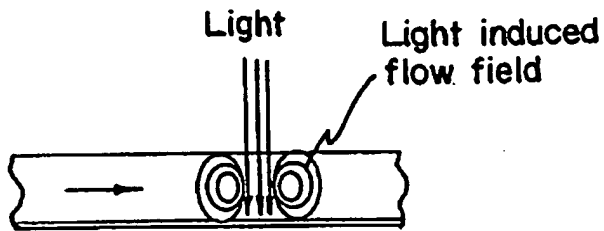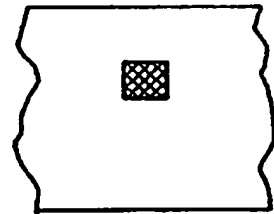
FIG. IIe
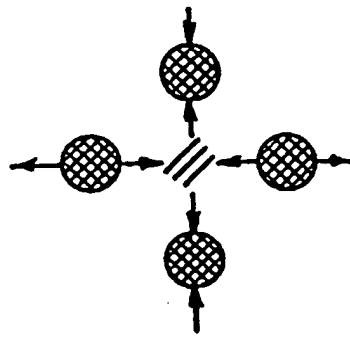
ILLUMINATION PATTERN GENERATOR

Observation
Camera

Projected
Illumination
Pattern

LCD

VGA

Light
Source

Application
Software

PC

Illumination
Pattern

Fig 12
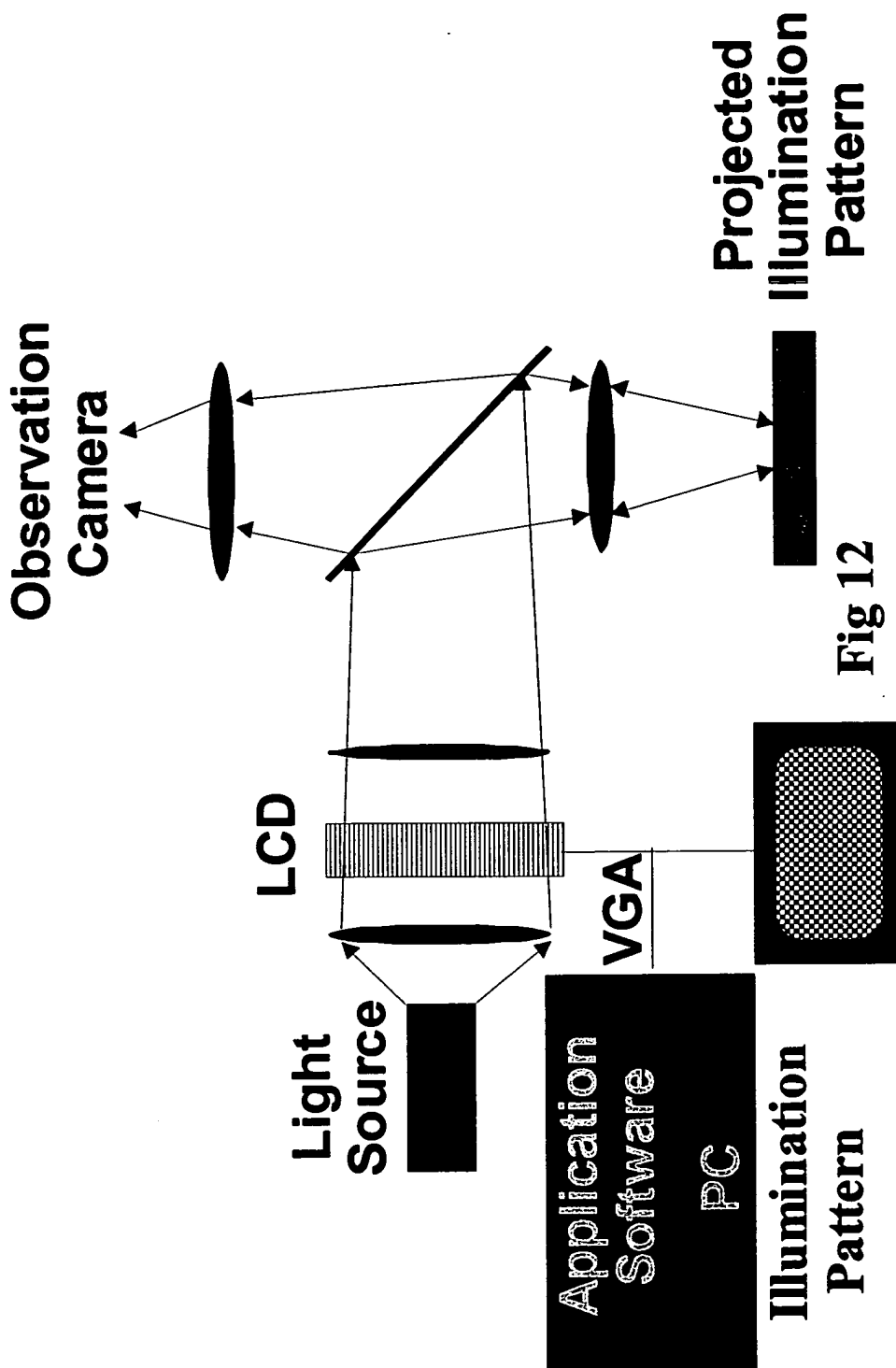
LCD-PARSE OPTICAL DESIGN
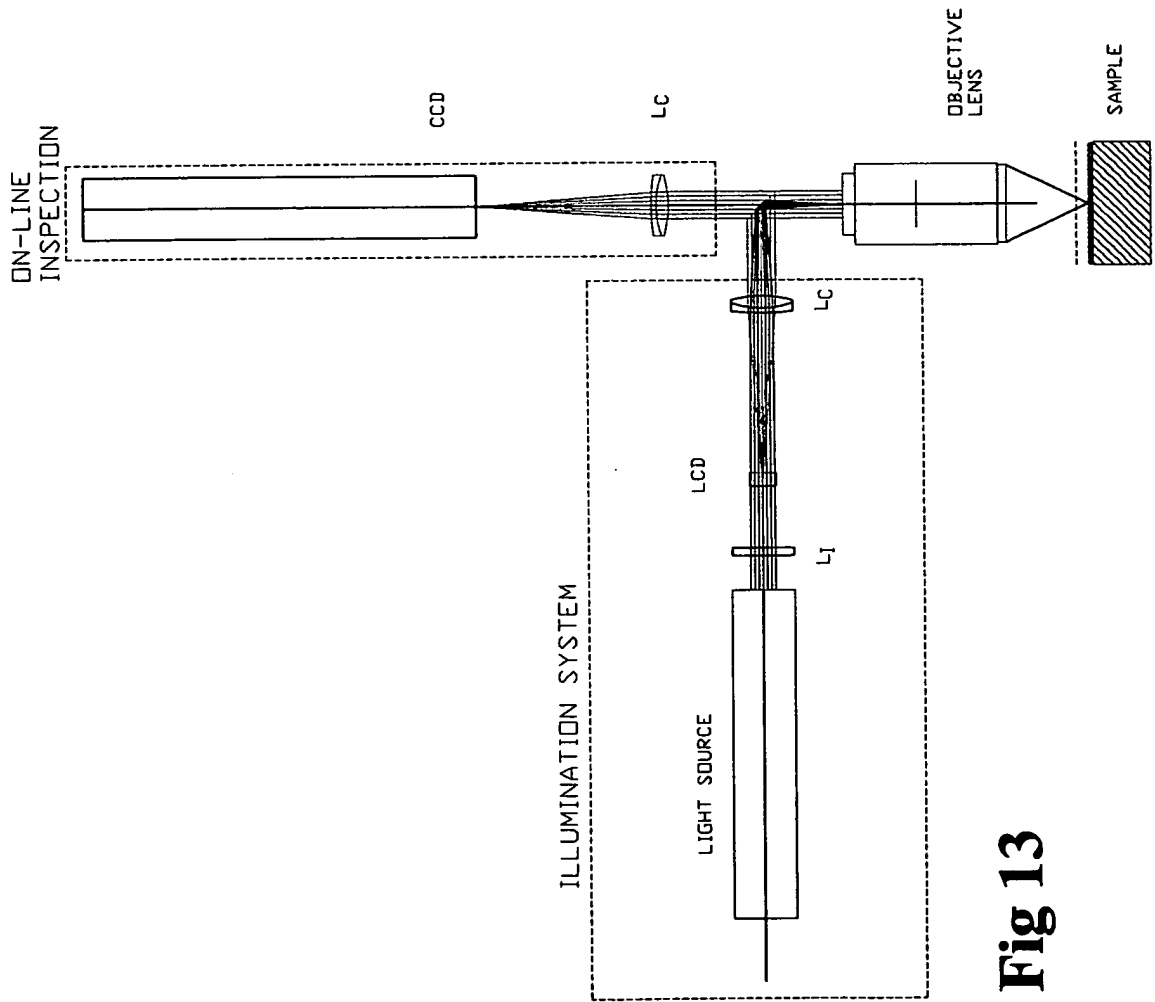
Fig 13

ARRAY SHAPE ADJUSTMENTS

CIRCLE
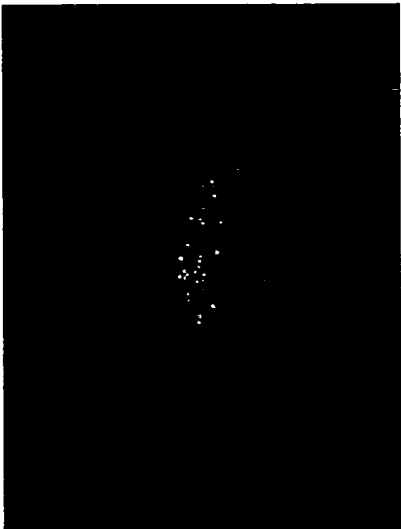
HORIZONTAL LINE

Figure 14c

Figure 14a

VERTICAL LINE

SQUARE

Figure 14d

Figure 14b

COLLECTION AND ARRAY ASSEMBLY

CollectedParticles

14_05_99 16-53-13.bmp 2.2um bead attract to lighted area at 10KhZ, 10VP-P, 1V off, 0.2A Laser
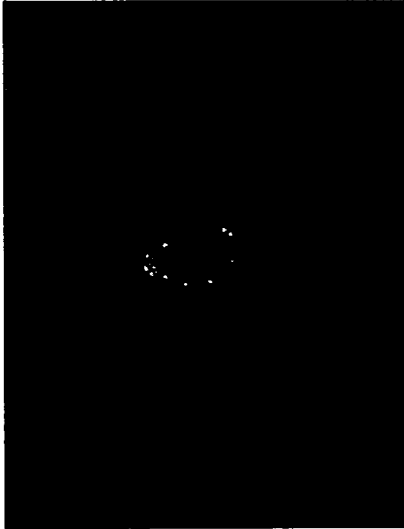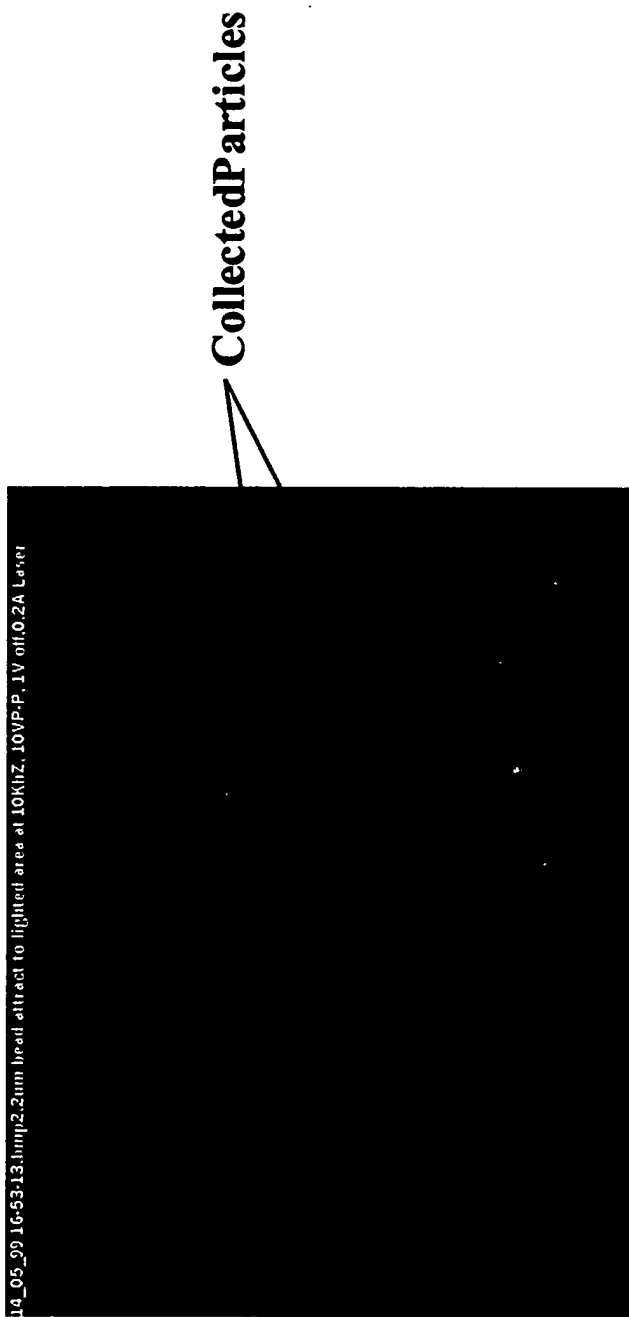
Figure 15a

EXPULSION AND CONFINEMENT

Confined Particles

Illuminated Regions

"Ghost" Image

Figure 15b

DRAG AND DROP
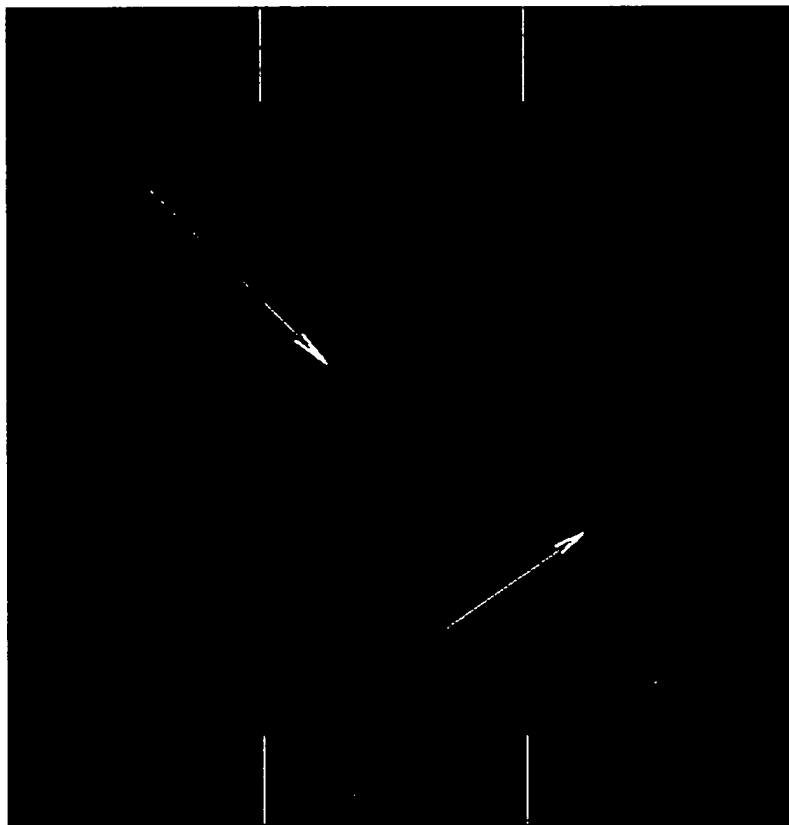
Figure 16

Porgrammable Array Reconfiguration and Segmentation

Dynamic Bead Array
with Labeled Subarray

Illumination Profile

Illumination of
Subarray Boundary

Array Segmentation
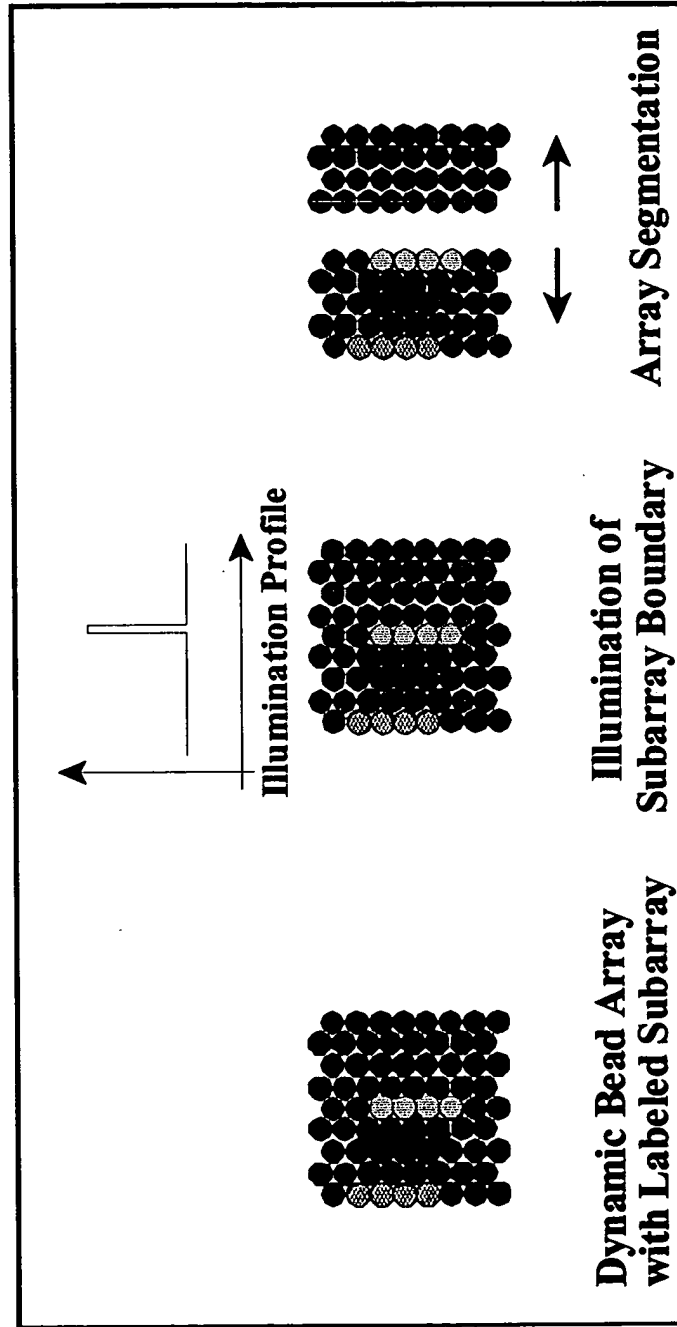
Figure 17

LCD PARSE
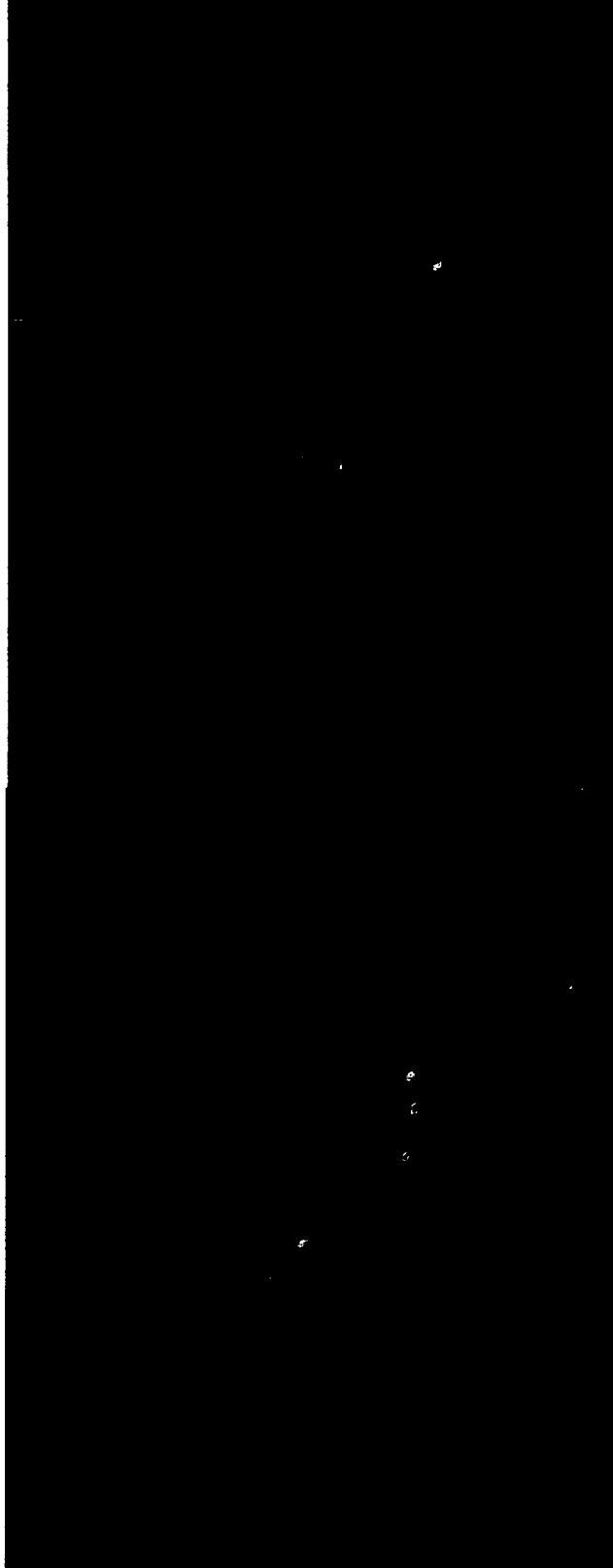
Figure 18a

Figure 18b

LCD PARSE

Figure 19

FRACTIONATION

Differential Frequency Dependence of Particle Expulsion
(NOTE: ω_c denotes a characeristic frequency)

Single Particle (Type 1)

Mixture (Types 1, 2)
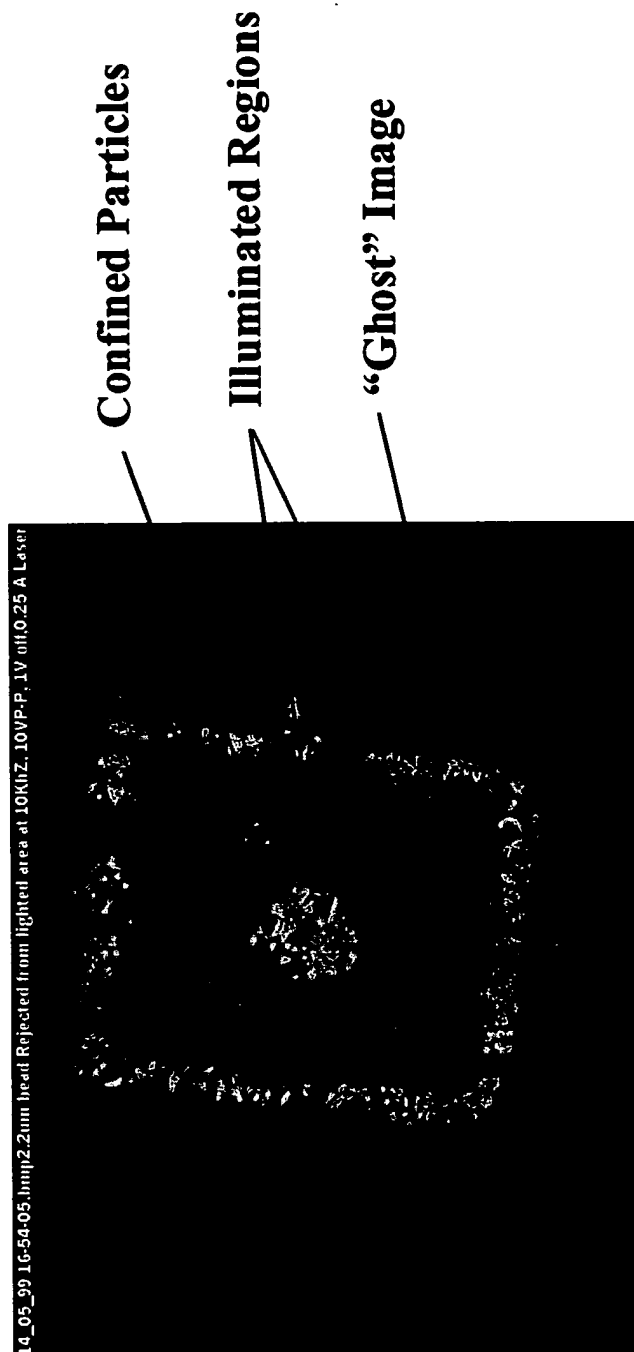
Particle Collection and Array Assembly $\omega < \omega\_c$

Particle Expulsion $\omega\_c < \omega$

Particle Type 1

Particle Type 2

Differential Expulsion $\omega\_c(1) < \omega < \omega\_c(2)$

ω_c (Type 1) $< \omega\_c$ (Type 2)

Figure 20a

FRACTIONATION

Illuminated Region

Small particles collected in illuminated rgion
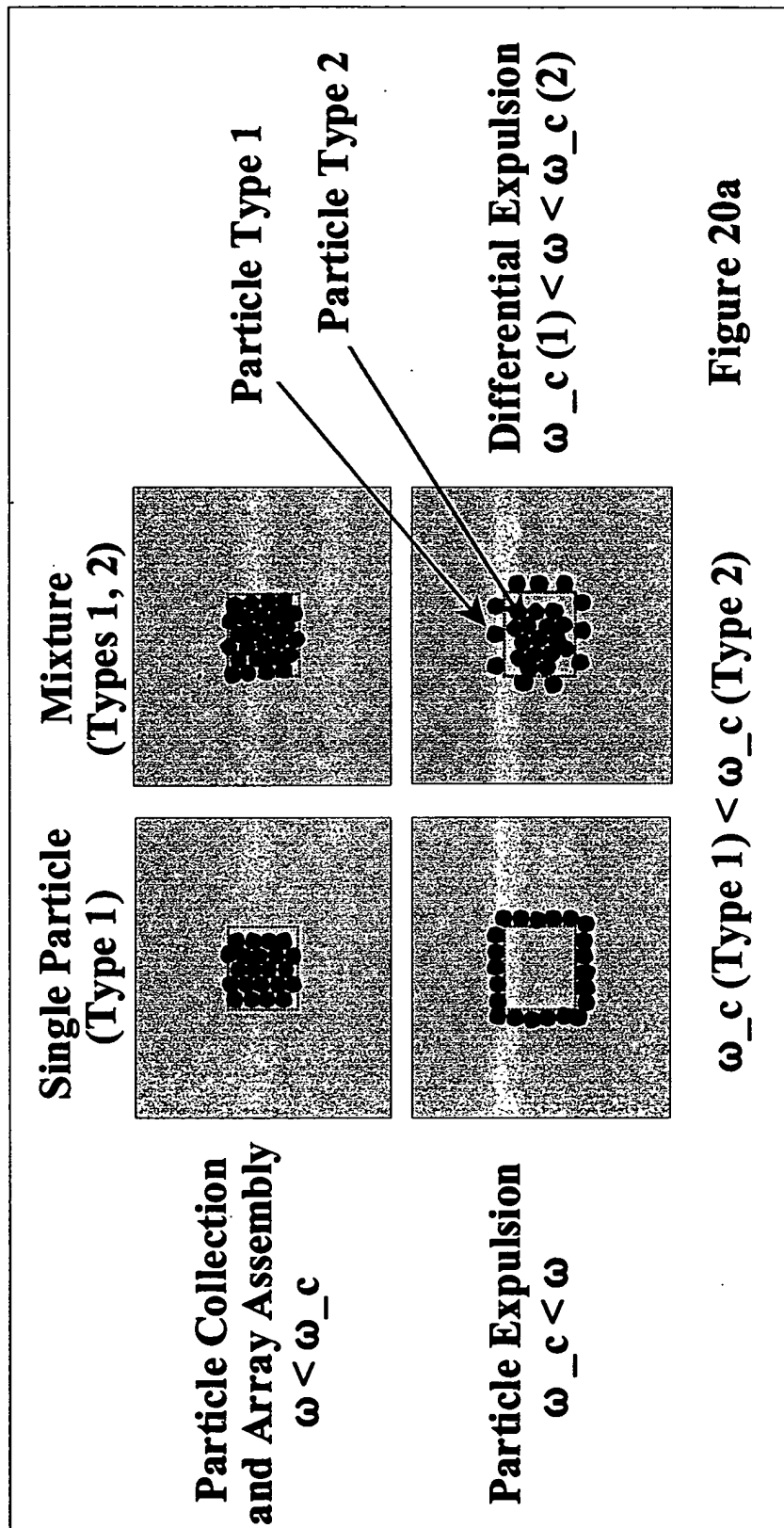
Large particles expelled from illuminated rgion
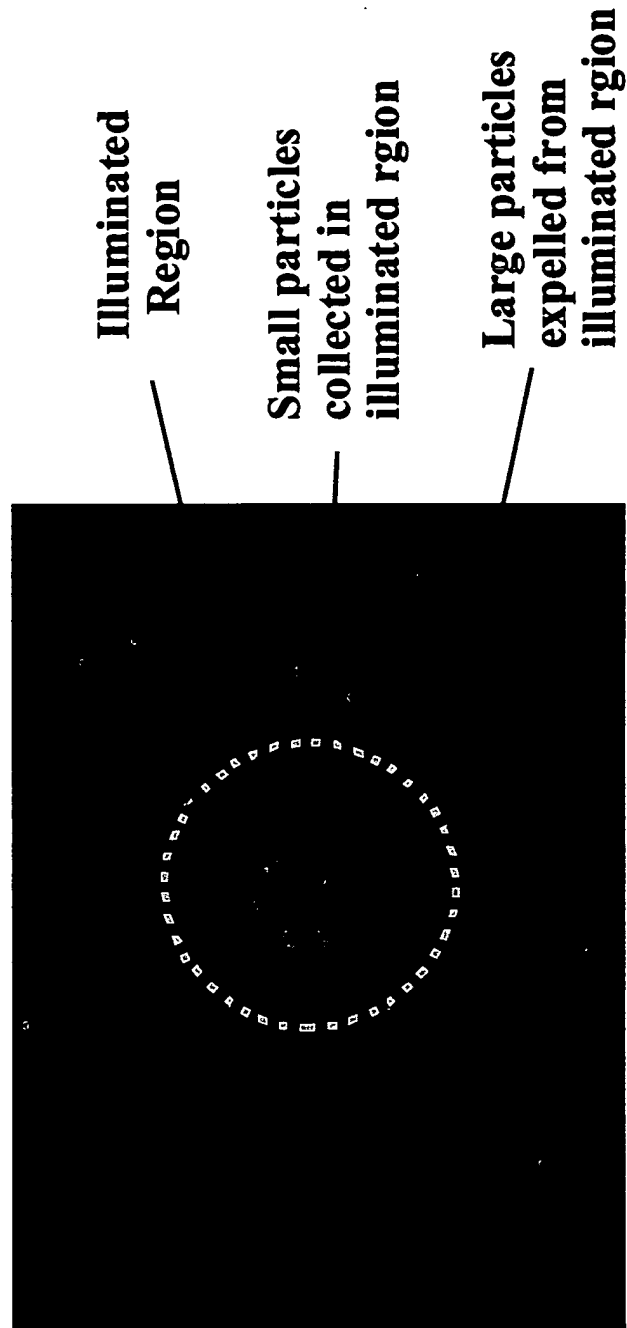
Figure 20b

LCD PARSE
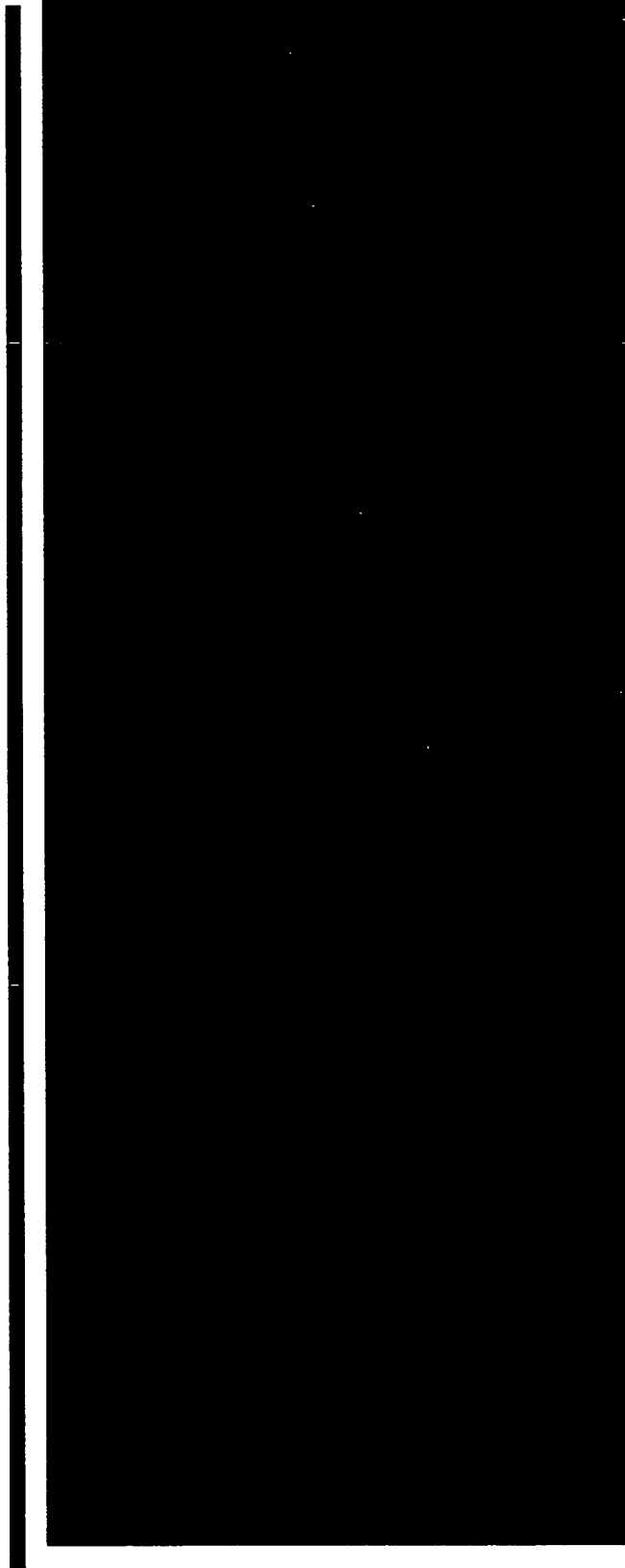
Figure 21a

Figure 21b

Encoding Methodologies

A. CHEMICAL ENCODING

Single Step Carrier Coding

- Optical
  - bulk staining (1-100)
  - "stacking"
- Dielectric (1-6)

Multiple Step Reaction Coding

- Optical
  - Surface labeling (2^n)

Multi-Site:
Droplet Array Deposition

Multi-Step:
Random Sequential Injection

Figure 22a

B. SPATIAL ENCODING
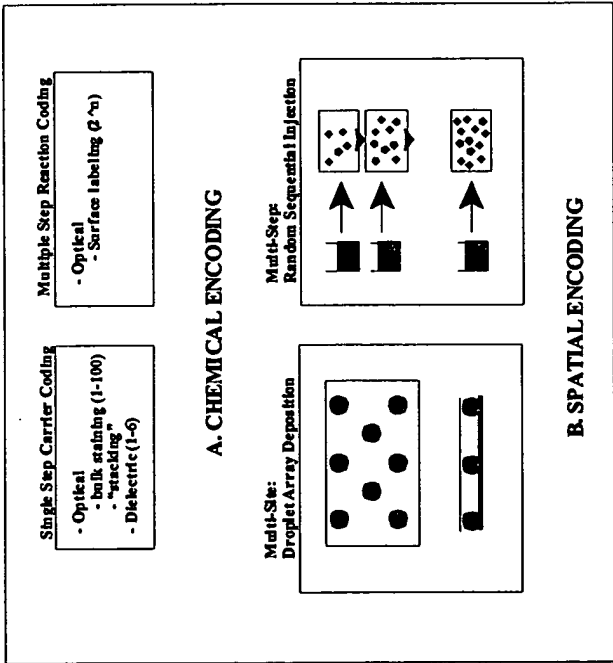
1 - Pre-Processing

2 - Post-Processing
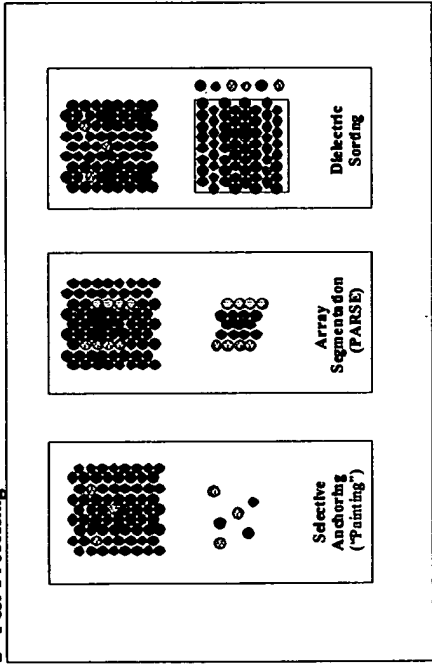
Selective Anchoring ("Painting")

Array Segmentation (PARSE)

Dielectric Sorting

Figure 22b

RANDOM SEQUENTIAL INJECTION

Figure 23

SEQUENTIAL INJECTION & LIGHT-CONTROLLED ARRAY PLACEMENT
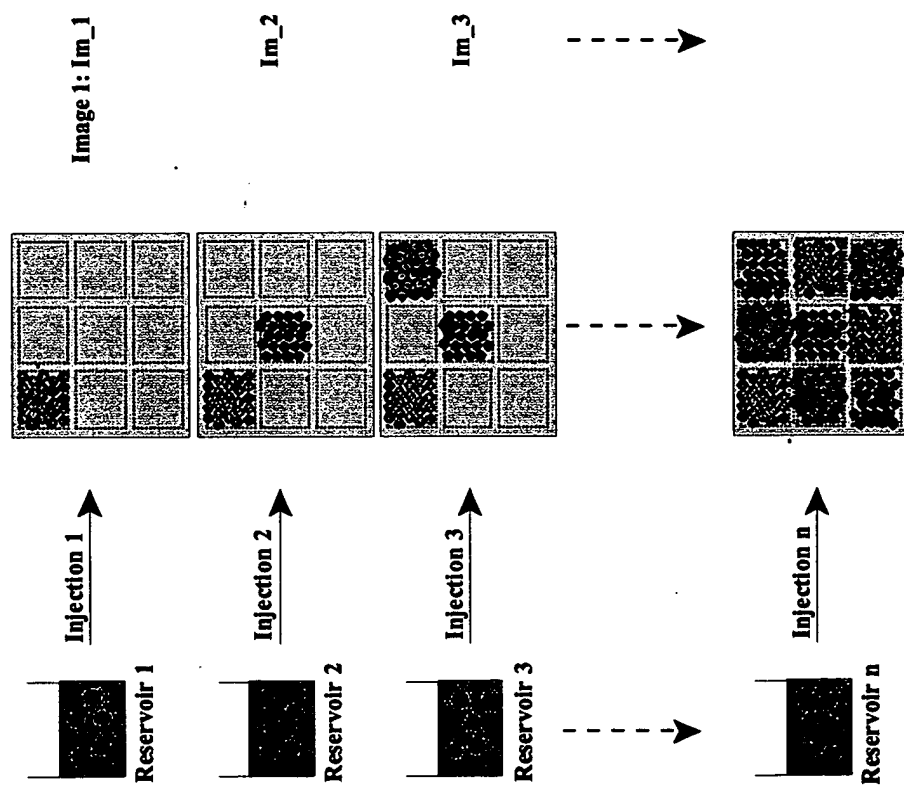
Figure 24

MACRO-TO-MICRO TANSITION

WELLS

CHIP

BEAD
ARRAYS
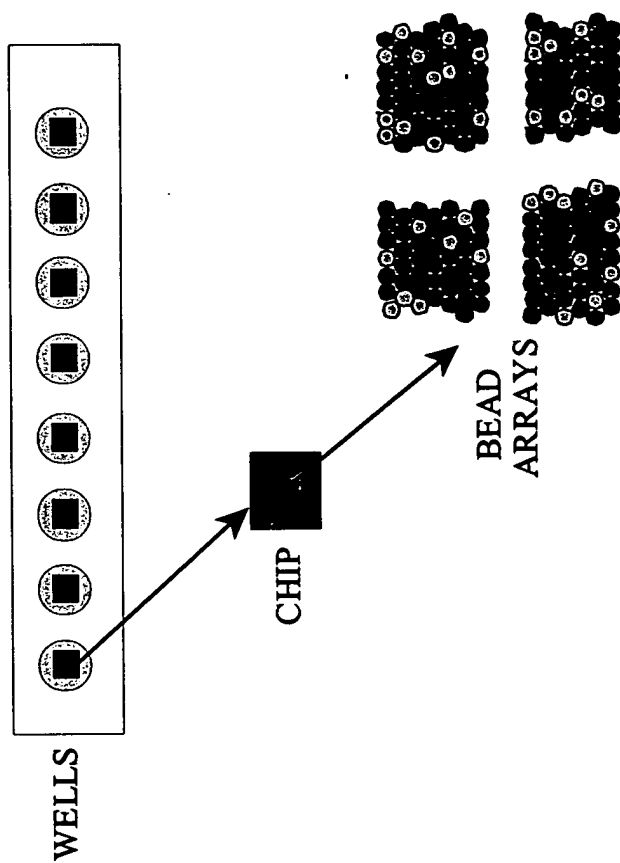
Figure 25a

ARRAY ENCODING
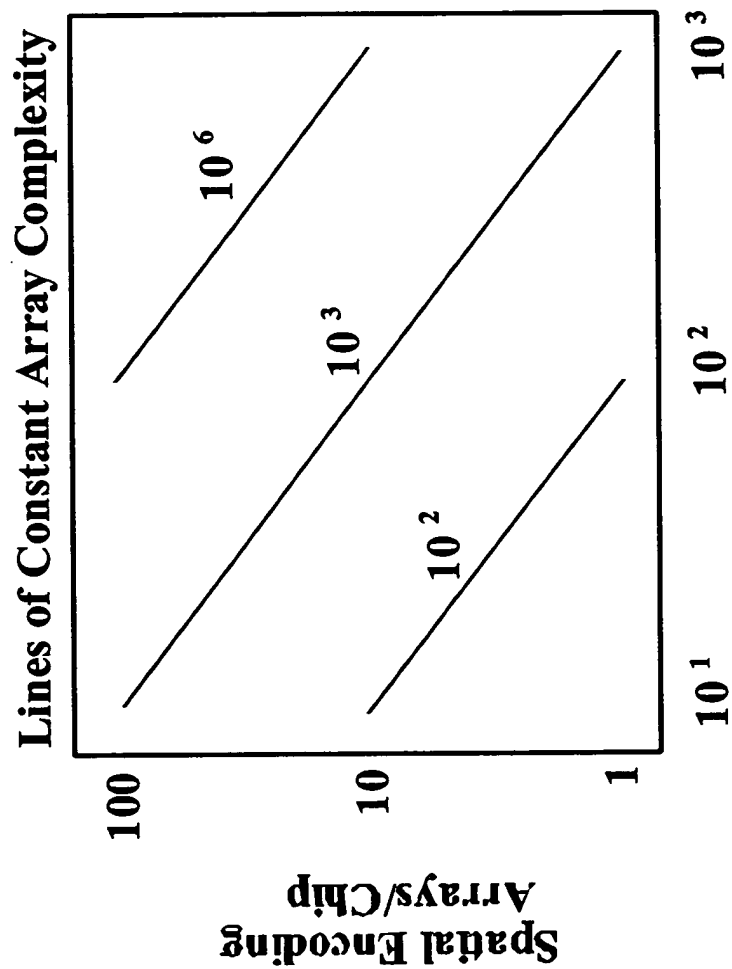
Figure 25b

ARRAY ENCODING

Reservoirs

r1 r2 r3 r4

Chip With
Multiple
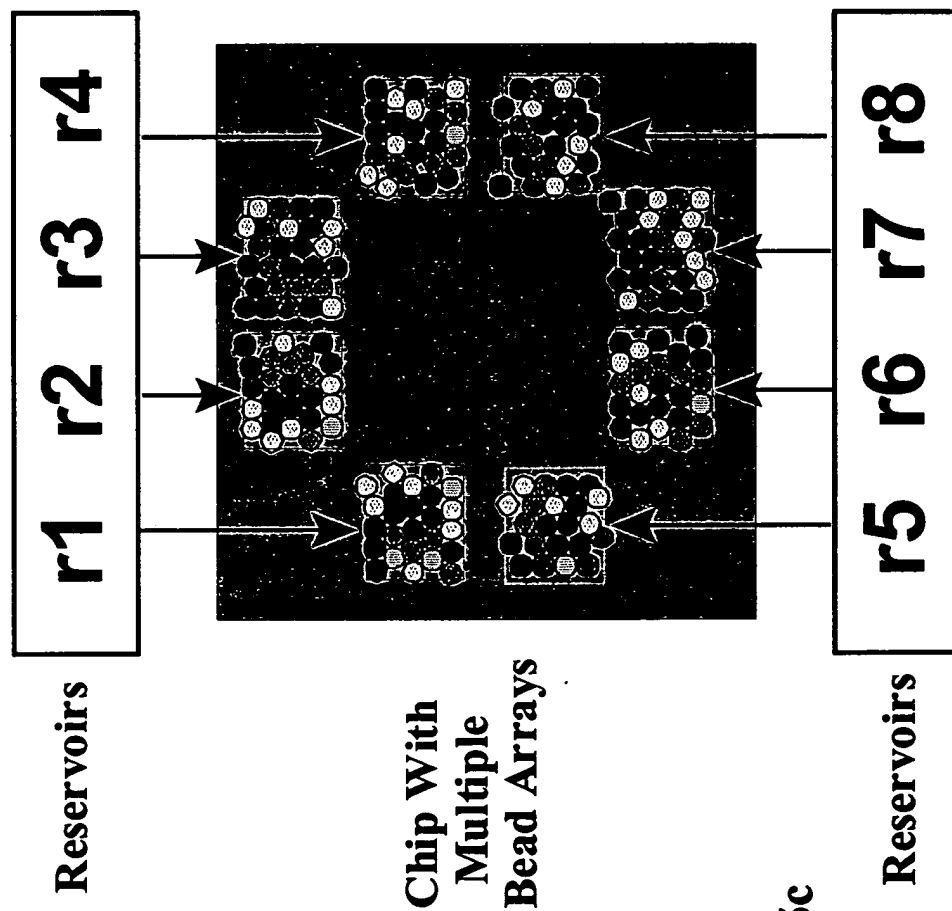Bead Arrays

Reservoirs

r5 r6 r7 r8

Figure 25c

SEQUENTIAL ASSEMBLY: "BANDING"
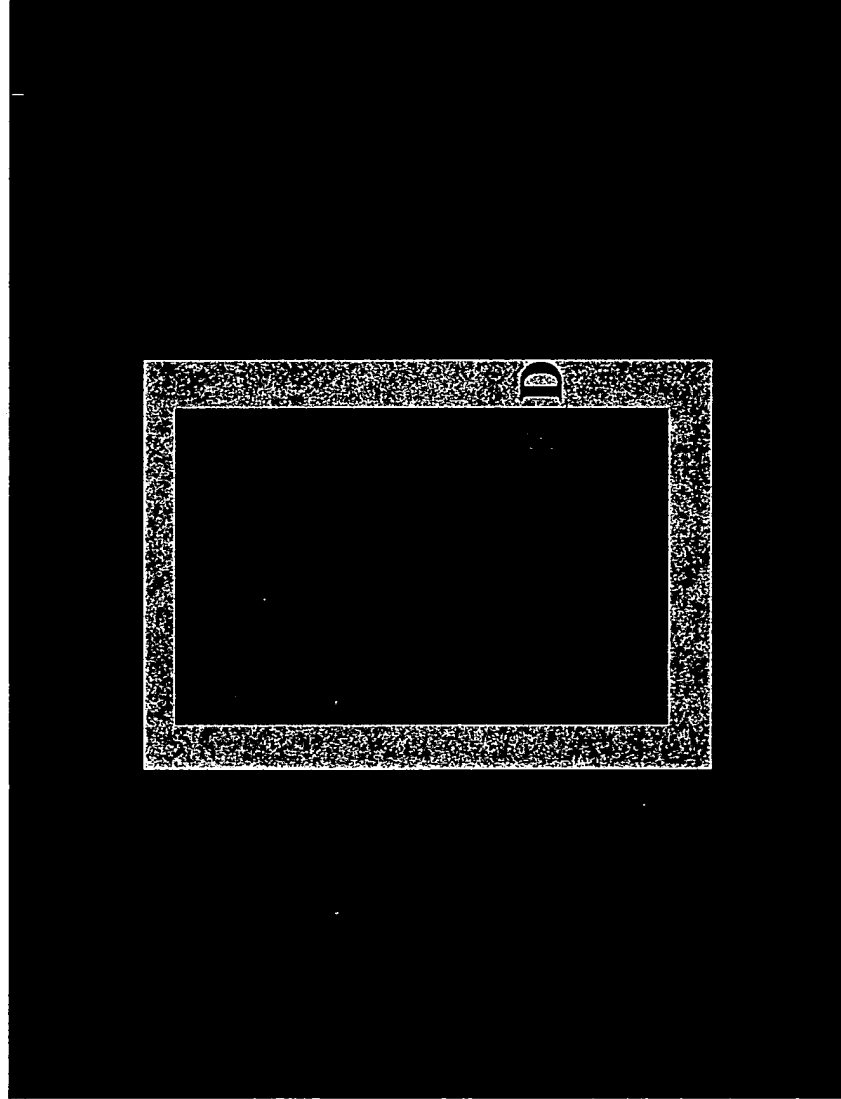
Figure 26a

SEQUENTIAL ASSEMBLY: "BANDING"

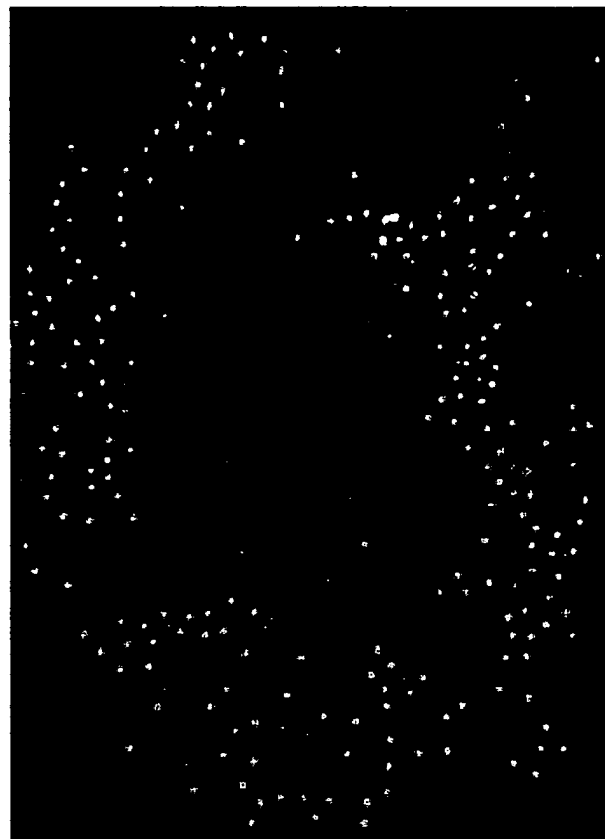## Mixture of Two Particle Types

Brightfield Image
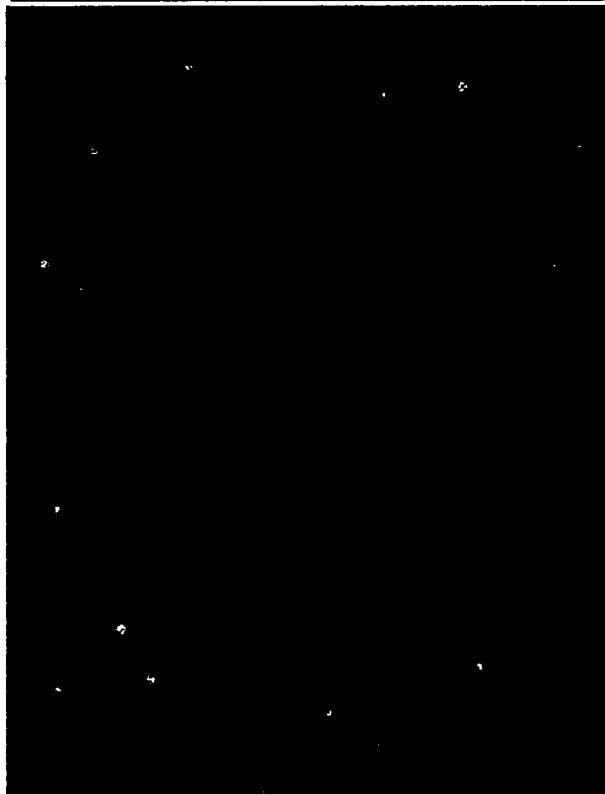
Darkfield Image

2.8 μm   5.5 μm

2.8 μm   5.5 μm

Figure 26b

LCD PARSE

Figure 27
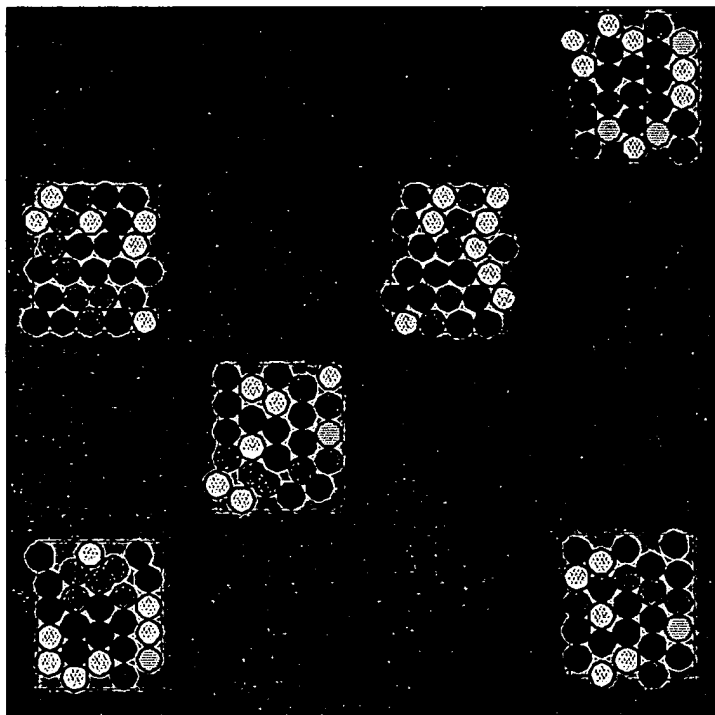
ARRAY OF RANDOM SUBARRAYS

A UNIQUE TWO-DIMENENSIONAL BAR CODE
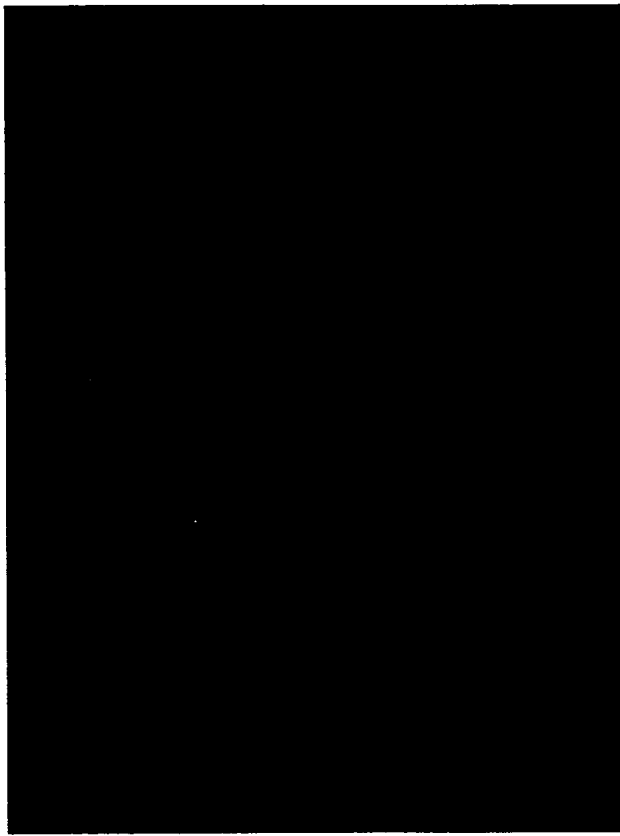

Figure 28

LIGHT-INDUCED FLUID FLOW

Figure 29